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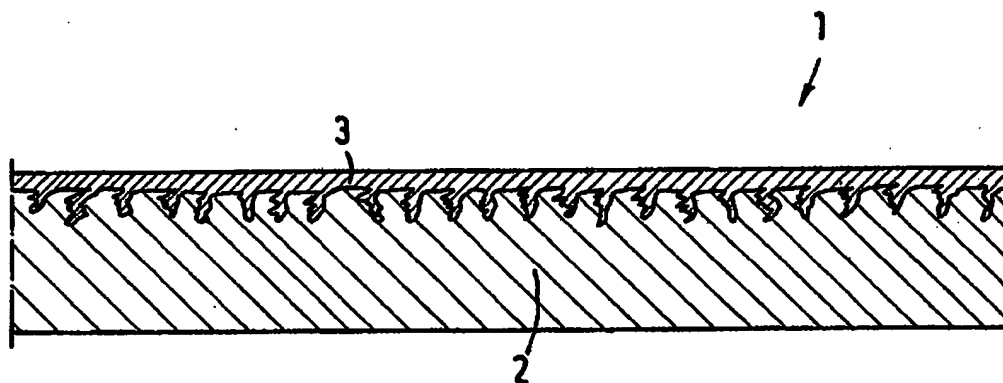
(54) **Paper for packing purposes, and a process for its manufacture**

(57) A paper for packing purposes, particularly for use in the manufacture of corrugated cardboard, is made from waste paper and afforded good strength and finish by a surface sizing with gelatinized starch from cereals and/or tubers and/or roots together with proteins contained in these materials after dispersion or solution. The sizing may consist of gelatinized starch and cereal proteins of a normal commercial wheat and, if required, a small addition of an oxidizing agent, e.g., ammonium persulphate. Fibrous material separated from the gelatinized starch may be added to the waste paper constituent.

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## SPECIFICATION

Paper for packing purposes, and a process for its manufacture

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This invention relates to a paper for packing purposes, particularly for use in the manufacture of corrugated cardboard, which is manufactured with surface sizing using a predominant proportion of sorted and/or unsorted waste paper and also paper additives as required. By paper additives are to be understood fillers, colouring materials, wetting and anti-static agents, moisture-repelling agents, etc.

In paper making the use of waste paper is known, particularly when manufacturing lower-quality grades, frequently the waste paper is subjected to sorting before use, to remove impurities and foreign bodies. Subsequently the waste paper is converted into a watery suspension in so-called pulping machines; it is beaten and, with addition of paper additives if required, is blended as a paper pulp. The paper pulp is then formed into a continuous paper web on a paper-making machine and is dried after preliminary de-watering. De-watering normally takes place on an endless sieve on which a mat is formed from the diluted paper pulp applied to it. This mat is then further de-watered by suction and/or pressing. Finally a large part of the remaining water is evaporated by supplying heat during a final drying process.

When paper for packing purposes, particularly for further processing into corrugated cardboard, is manufactured exclusively or predominantly from waste paper, the mechanical properties required of the paper are not readily achieved. These properties are primarily characterized by the concepts of surface crushing pressure and corner crushing resistance or ring crushing pressure. Surface crushing pressure is described in DIN 53 143/44, corner crushing resistance in DIN 53 149 and ring crushing pressure in the description of American testing method ASTM 1164. The mechanical properties can of course be obtained if the proportion of waste paper in the raw materials mix is reduced and expensive cellulose materials such as e.g. kraft cellulose are used. As a result of the greater strength of such cellulose materials the paper manufactured from them also becomes stronger. A further possibility of improving the mechanical properties of paper is so-called "sizing", in which various binding materials are added to the paper in course of its manufacture, and they improve both the internal texture of the paper and thereby its mechanical properties and, when applied appropriately to the paper, the properties of its surface. The application of the binding material can take place either as so-called body sizing, by adding the binding material or materials to the paper pulp before forming the mat, or by so-called surface sizing in which the binding material or materials after suitable pre-treatment are applied to the surface of the paper during its manufacture.

The application of surface sizing can take place e.g. by means of sizing presses. Sizing presses as a rule possess two counter-rotating rolls through which the paper web is passed and which thereby force a

mixture of size into the paper web and/or distribute it over the surface. There is however also the possibility of spraying the size mixture on to the paper web during paper manufacture. Here spraying can take place either on one side or on both sides. Thus by applying gelatinized maize starch to paper which predominantly consists of reconstituted waste paper the same mechanical properties are achieved as if this paper consisted only partly of waste paper, the remainder being cellulose. A similar effect is obtained if the paper is treated by spraying with a starch solution.

The object of the invention is to produce a paper for packing purposes, particularly for the manufacture of corrugated cardboard, which can be manufactured at low cost by simple means, predominantly using waste paper.

According to the present invention, paper having a waste paper proportional of up to 100% of the fibrous raw material used has additional material for surface sizing consisting of cereal matter and/or tubers and/or roots which, after gelatinization of the starches contained in the additional materials together with the proteins contained in the additional materials after dispersion or solution, is applied to the surface of the paper being manufactured. The invention starts from the recognition that the manufacture of paper generally allows cheap raw materials and cheap additional materials to be used, which can not only be added to the materials in suspension in the course of re-cycling but additionally serve at the same time to produce a modified form of sizing material of gelatinized starch and dispersed, or possibly dissolved, proteins. At the same time one can avoid using for this purpose high-grade and therefore expensive starches such as e.g. potato starch or maize starch. Suitable cereals are e.g. wheat, rye, millet, maize-corn or the like, suitable tubers include potatoes or the like, suitable roots are manioc, taro or the like. After gelatinization of the starch content, and separation either by sieving or by centrifuging, it is within the scope of the invention to add to the materials in suspension the fibres and pieces of husk contained in the raw material from grain and/or tubers and/or roots, in accordance with their fibrous character, before feeding this suspension into the paper-making machine.

Further preferred features of the invention are stated below. Thus the invention can be carried out in a way which provides that the surface sizing consists of gelatinized starch and dispersed and/or dissolved proteins of wheat (*triticum vulgare*) and if necessary a small addition of ammonium persulphate. Whilst the wheat proteins, by building up a skeleton structure, serve to increase the bonding forces, the ammonium persulphate addition provides a reduction of viscosity of the sizing material. When the gelatinized wheat-starch is applied to the web of paper it may be partly forced into it so that the result is a paper that possesses the following specific properties:-

|                         |                        |
|-------------------------|------------------------|
| Weight/unit area:       | 128 g/m <sup>2</sup>   |
| Size coating            | 8 g/m <sup>2</sup>     |
| Bursting pressure       | 4.1 bar                |
| CMT (Surface crushing   |                        |
| 5 pressure according to |                        |
| DIN 53 143)             | 280                    |
| Denison pluck value     | 12                     |
| Corner crushing         |                        |
| resistance according    |                        |
| 10 to DIN 53 149        | 23 kgf/cm <sup>2</sup> |

According to another method of carrying out the invention the surface sizing is sprayed on to the paper web after gelatinization of the starch present in the wheat to produce a paper that possesses the

15 following specific properties:—

|                          |                        |
|--------------------------|------------------------|
| Weight/unit area         | 132 g/m <sup>2</sup>   |
| Size coating             | 13 g/m <sup>2</sup>    |
| Bursting pressure        | 3.6 bar                |
| CMT (Surface crushing    |                        |
| 20 pressure according to |                        |
| DIN 53 143)              | 190                    |
| Denison pluck value      | 16                     |
| Corner crushing          |                        |
| resistance according     |                        |
| 25 to DIN 53 149         | 22 kgf/cm <sup>2</sup> |

In this case unsorted waste paper was exclusively used as raw material and a mixture exclusively used as raw material and a mixture of water and wheat, after gelatinization of the starch present in the wheat

30 and subsequent removal by sieving of the husk portion of the wheat, was sprayed on to the paper web before its final drying process.

In a process for the manufacture of paper in accordance with the invention, particularly for the man-

35 ufacture of corrugated cardboard, unsorted and/or sorted waste paper is purified with cellulose if required, disintegrated in a pumping machine with addition of water, and transformed into a watery suspension, beaten, and with the addition of paper

40 additives if required blended as a paper pulp, then formed into a continuous paper web and in course of a de-watering process undergoes preliminary drying, being subsequently sized on its surface and finally dried. This process is characterized in that 2%

45 or more of additional material consisting of cereals and/or dried tubers and/or roots is added to up to 98% of waste paper, and that the starch contained in the additional material after partial or complete gelatinization, and the dispersed or dissolved pro-

50 teins, is applied to the surface of the paper web for surface-sizing purposes before its final drying. In doing this the sizing medium can be pressed on to the paper web or pressed into it, or can be sprayed on.

According to an aspect of the invention of particu-

55 lar preference cereals of commercial quality are cleaned, stirred up with water and wet-pulverised, the resulting mixture is thermally and mechanically treated by steam under pressure, and from the resulting mixture of dissolved gelatinized starch,

60 partially dissolved, partially dispersed cereal proteins, and fibrous material from the husks of cereal grains, the fibrous material is removed, e.g. by sieving or by centrifuging, and added in specified quantity as additional material to the waste paper con-

proteins is supplied to the paper web as sizing. Before application to the paper web, the starch present in the cereal is preferably gelatinized in the presence of the other constituents of the cereal in the

70 watery phase at temperatures of more than 50°C, preferably at 120°C. The starch may be further broken down after gelatinization and before application to the paper web. 0.5 to 2.0% by weight, preferably 1% by weight, of ammonium persulphate or

75 another oxidizing agent is preferably added to the mixture before, during or after wet-pulverization to reduce viscosity after the subsequent gelatinization. As an example, 100 kg. of wheat of normal commercial quality, after cleaning to remove sand, dust,

80 straw etc., was stirred up with 20 times the quantity of water in a container with stirring mechanism and the mixture was subjected to wet-pulverization. Before wet-pulverization 0.85 kg. of ammonium per-

85 sulphate was added to the mixture for the purpose of reducing viscosity after the subsequent gelatinization. After wet-pulverization this mixture was sub-

jected to thermal and mechanical treatment by being conveyed by means of a constant-feed pump together with steam at 1.6 bar excess pressure. This

90 mixture thus obtained of dissolved gelatinized starch with corn proteins which were partly dissolved and partly dispersed, and fibrous material from the husks of the wheat grains was then delivered to a vibrating screen to remove the fibrous materials. 14.3 kg. were

95 sieved out. The fibrous materials sieved out were added to the waste paper in the suspension. Finally, after application of the size mixture with wheat proteins in a sizing press, the paper was subjected to a treatment in which it was passed over several

100 steam-heated drying cylinders.

According to another method of carrying out the invention shredded taro roots are cleaned and wet-pulverized in water, the resulting mixture is thermally treated by steam under pressure, and from the

105 mixture of dissolved gelatinized starch and a dispersion of insoluble constituents thereby obtained these constituents are removed e.g. sieved or centrifuged out, and a predetermined quantity of such constituents is added to the charge of waste paper in

110 the pulping machine, whilst the gelatinized starch together with the proteins is conveyed to the paper web for sizing. Thus in this case the mixture employed for surface sizing is obtained, not from cereals, but from 80 kg. of dried, shredded taro root. After

115 gelatinization of the starch content and dispersion of the insoluble components a quantity of 3.2 kg., which is 4% of the original weight of root, was sieved out and, in order that use could be made of it, was added to the waste paper in the pulping machine. 82

120 g. of root constituents was contained in each kilogram of manufactured paper.

The advantages achieved by the invention are essentially to be seen in that a paper for packing purposes, particularly for the manufacture of corru-

125 gated cardboard, and a process are specified, in accordance with which the paper can be manufactured from waste paper in particularly simple and economical manner, on the one hand making use of cheaper additional materials and on the other hand producing gelatinized starch from these cheap addi-

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tional materials, so that the otherwise normal employment of expensive sizing materials using high-grade starch can be avoided. The strength of the paper is considerably increased by the proteins contained together with the starch in the cereals and/or in the tubers and/or in the roots, which according to the invention are not separated from the starch but are applied to the paper web in dispersed or dissolved form with the gelatinized and possibly still further broken-down starch.

In describing the invention further, reference will be made to the accompanying drawing, the single Figure of which shows a section through paper according to the invention. The paper 1 comprises waste paper 2 and possibly paper additives, and features a surface sizing 3 which partly infiltrates into the waste paper and partly forms a thin surface skin. The waste paper proportion amounts to up to 98%, whilst the remaining 2% or more consists of additional material from cereals and/or dried tubers and/or roots, in which the surface sizing 3 is based on the starch contained in the additional material together with the proteins contained in the additional material after their dispersion or solution. The surface sizing 3 can be pressed on to the paper web of waste paper 2 or can be sprayed on. An intimate bond to the web of paper is always ensured.

#### CLAIMS

1. A paper comprising a waste paper proportion of up to 100% of the fibrous raw material used, and additional material for the surface sizing consisting of cereals and/or tubers and/or roots which, after gelatinization of the starches contained in the additional materials together with the proteins contained in the additional materials after dispersion or solution, is applied to the surface of the paper being manufactured.

2. A paper as in Claim 1, wherein the surface sizing consists of gelatinized starch and cereal proteins of a normal commercial quality wheat.

3. A paper as in Claim 2, with a small addition of an oxidizing agent to the sizing.

4. A paper as in Claim 3, wherein the oxidizing agent is ammonium persulphate.

5. A paper as in any one of Claims 1 to 4, wherein the surface sizing is applied to the web of paper and is partly forced into it so that the paper possesses the following specific qualities:-

|   |                        |
|---|------------------------|
| Weight/unit area  | 128 g/m <sup>2</sup>   |
| Size coating  | 8 g/m <sup>2</sup>     |
| Bursting pressure                                       | 4.1 bar                |
| CMT (Surface crushing pressure according to DIN 53 143) | 280                    |
| Denison pluck value                                     | 12                     |
| Corner crushing resistance according to DIN 53 149      | 23 kgf/cm <sup>2</sup> |

6. A paper as in any one of Claims 1 to 4, wherein the surface sizing is sprayed on to the web of paper to produce a paper that possesses the following specific qualities:-

|                   |                      |
|-------------------|----------------------|
| Weight/unit area  | 132 g/m <sup>2</sup> |
| Size coating      | 13 g/m <sup>2</sup>  |
| Bursting pressure | 3.6 bar              |

CMT (Surface crushing pressure according to DIN 53 143)

190

Denison pluck value

16

70 Corner crushing resistance according to DIN 53 149

22 kgf/cm<sup>2</sup>

7. A process for the manufacture of paper in which unsorted and/or sorted waste paper is disintegrated in a pulping machine with addition of water and transformed into a watery materials suspension, beaten, and blended as a paper pulp, then formed into a continuous paper web and in course of a de-watering process undergoes preliminary drying, being subsequently sized on its surface and finally dried, 2% or more of additional material consisting of cereals and/or dried tubers and/or roots being added to up to 98% of waste paper, and the starch contained in the additional material being applied, after partial or complete gelatinization, to the surface of the paper web for surface sizing purposes before its final drying.

8. A process as in Claim 7, wherein cereals of normal commercial quality are cleaned, stirred up with water and wet-pulverized, the resulting mixture is then thermally and mechanically treated by steam under pressure and from the resulting mixture of dissolved gelatinized starch, partly dissolved, partly dispersed cereal proteins and fibrous material the fibrous material is removed and added in specified quantity as additional material to the waste paper constituent, whilst the gelatinized starch with the cereal proteins is supplied to the paper web as sizing.

9. A process as in Claim 7 or 8, wherein the starch present in the cereal is gelatinized in the presence of the other constituents of the cereal in the watery phase at temperatures of more than 50°C before application to the paper web.

10. A process as in the Claim 9, wherein the temperature is 120°C.

11. A process as in any one of Claims 7 to 10, wherein the starch is further broken down after gelatinization before application to the paper web.

12. A process as in any one of Claims 7 to 11, wherein 0.5% to 2.0% by weight of an oxidizing agent is added to the mixture during wet-pulverization to reduce viscosity after the subsequent gelatinization.

13. A process as in Claim 12, wherein the oxidizing agent is 1% by weight.

14. A process as in Claim 12 or Claim 13, wherein the oxidizing agent is ammonium persulphate.

15. A process as in Claim 7, wherein shredded roots of taro or manioc are cleaned and wet-pulverized in water, the resulting mixture is then thermally and mechanically treated by steam under pressure, from the mixture of dissolved gelatinized starch and a dispersion of insoluble constituents these constituents are removed, and a predetermined quantity of such constituents is added to the charge of waste paper in the pulping machine, whilst the gelatinized starch together with the proteins is conveyed to the paper web for sizing.

16. A paper-substantially as hereinbefore described and with reference to the accompanying

drawing.

**17. A process for the manufacture of paper substantially as hereinbefore described.**

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